

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
United States Patent and Trademark  
Office  
Box PCT  
Washington, D.C.20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

<b>Date of mailing (day/month/year)</b> 23 June 2000 (23.06.00)	
<b>International application No.</b> PCT/GB99/03521	<b>Applicant's or agent's file reference</b> 24.67173/001
<b>International filing date (day/month/year)</b> 25 October 1999 (25.10.99)	<b>Priority date (day/month/year)</b> 26 October 1998 (26.10.98)
<b>Applicant</b> COLLIER, David et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
25 May 2000 (25.05.00)

☐ in a notice effecting later election filed with the International Bureau on:  
\_\_\_\_\_

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Pascal Piriou

Telephone No.: (41-22) 338.83.38

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 24.67173/001	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/03521	International filing date (day/month/year) 25/10/1999	Priority date (day/month/year) 26/10/1998
International Patent Classification (IPC) or national classification and IPC E02B17/02		
Applicant OVE ARUP PARTNERSHIP LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 8 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 25/05/2000	Date of completion of this report 14.02.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer De Coene, P Telephone No. +31 70 340 2730 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB99/03521

**I. Basis of the report**

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

**Description, pages:**

1-15 as originally filed

**Claims, No.:**

1-38 as originally filed

**Drawings, sheets:**

1/11-11/11 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB99/03521

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.  
☐ paid additional fees.  
☐ paid additional fees under protest.  
☐ neither restricted nor paid additional fees.

2. ☒ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.  
☒ not complied with for the following reasons:  
**see separate sheet**

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.  
☐ the parts relating to claims Nos. .

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	1-37
	No:	Claims	38
Inventive step (IS)	Yes:	Claims	5-16, 22-36
	No:	Claims	1-4, 17-21, 37, 38

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB99/03521

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Industrial applicability (IA)    Yes:    Claims    1-38  
   No:    Claims

2. Citations and explanations  
**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

**Re Item IV**

**Lack of unity of invention**

1. The application contains three independent method claims, i.e. claims 17, 26 and 38. Whereas independent claims 17 and 38 with dependent claims 18-25 and 29-36 define a method of installing an offshore structure comprising the steps of jacking up the deck, locating the deck (see in particular claims 22-24), forming a permanent connection and removing the jacking system, independent claim 26 and its dependent claims 27 and 28 only define the step of locating the deck. As the method to locate a deck as such is known, the claims are not so linked as to form a single general inventive concept (Rule 13.1 PCT).

**Re Item V**

**Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. The statements are made with respect to the considerations concerning clarity given in Section VIII.
2. The subject-matter of claim 38 is not novel for the following reasons:

From US-A-3 974 657 (see in particular figures 67-69) a method of installing an offshore structure is known, the offshore structure comprising a base, a deck 160 and a plurality of legs 152 located outboard of the deck, the method comprising the steps of jacking the deck to the required height (see figures 67 and 68), forming a permanent connection between the deck and the legs (see figure 68) and removing the jacking system from the structure.

Thus all the features of claim 38 are known from US-A-3 974 657.

3. The subject-matter of claim 37 does not involve an inventive step for the following

reasons:

- 3.1 From US-A-3 974 657 (see in particular figures 67-69) an offshore structure is known comprising a base, a deck 160 and a plurality of legs 152 extending between the base and the deck, wherein the legs 152 are arranged outboard of the deck 160 and a connection is provided between each said leg and the deck.
- 3.2 The subject-matter of claim 37 differs from the known offshore structure in that the connection is provided at an inwardly facing face of each legs. The deck of the known offshore structure is connected on top of the leg. The problem to be solved by the present invention may be regarded as providing a suitable location on the legs to connect the deck. The difference is merely one of several straightforward possibilities (on top of, on a side of, on an outwardly facing face, ...) from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed. The skilled person would therefore regard it a normal design procedure to combine all the features set out in claim 37. Thus, the subject-matter of claim 37 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.
4. The subject-matter of dependent claims 1-4 and 17 (claims 1 and 17 can be considered dependent claims, see Section VIII, paragraph 1) concerns a type of leg which is generally used for offshore structures, see e.g. US-A-3 385 069. The subject-matter of dependent claims 18-20 comprises features concerning the guiding of the deck along the legs which are known or obvious from US-A-3 974 657, see in particular guides 143 in figures 60-62. The subject-matter of claim 21 appears to be known from US-A-3 974 657, see figures 67 and 68 respectively. The subject-matter of claims 1-4 and 17-21 therefore does not involve an inventive step (Article 33(3) PCT).

The dependent claims 5-16, 22-25 and 29-36 contain a multiplicity of features which relate to different embodiments of the subject-matter of claim 37 and 38 respectively. It appears that these claims could form a basis for an independent claim fulfilling the requirements of the PCT.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB99/03521

5. In order to overcome the objections in Section IV, V and VIII, the applicant should have limited the number of independent claims to two, i.e. one independent claim directed to an offshore structure, the second independent claim directed to the method of installing said offshore structure.

The first independent claim could have been based on claims 37 and 5 and include the features to form a permanent connection between the deck and the legs. As the invention seems to relate to the problem to provide a connection which allows to overcome tolerances in horizontal, vertical and angular alignment (see e.g. page 3, line 11 to page 4, line 5), such a structure claim should have defined all the features essential to overcome this problem (see e.g. page 13, line 6 to page 15, line 2; the insertion of merely the features of e.g. claim 5 would not have been adequate, as the above problem is not solved).

The second independent claim should in this case have been based on claim 38 and include the corresponding method steps of the independent structure claim.

**Re Item VII**

**Certain defects in the international application**

1. US-A-3 974 657 discloses features which should have been included in independent claim(s) which fulfill the requirements of the PCT. Accordingly, it would have been appropriate to draft such independent claim(s) in the two-part form as required by Rule 6.3(b) PCT, whereby the known features should be placed in the preamble.
2. The claims are to satisfy the criteria set forth in Article 33(1) PCT and the description should have been brought into conformity with such claims.
3. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in US-A-3 974 657 is not mentioned in the description, nor is this document identified therein.



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/GB99/03521

**Re Item VIII**

**Certain observations on the international application**

1. Apparatus claims 1 and 37 and method claims 17 and 38 have been drafted as separate independent claims. However, claims 1 and 17 comprise all the features of claims 37 and 38 respectively. Claims 1 and 17 are thus considered dependent claims. They should therefore have been reformulated by including at the beginning a reference to claims 37 and 38 respectively and only stating the additional features (i.e. said legs are lattice legs).
  
2. The subject-matter of claim 26 is not clear, as the steps of pulling an outer leg chord towards respectively pushing the adjacent leg chords away from the deck only appears to result in a cancelling out of the pushing and pulling forces. From the description it is evident (see in particular page 12, line 23 to page 13, line 5), that in addition the presence and the location of a guide and the inclination of the pushing forces result in a relatively accurate means of location of the deck in both the horizontal and vertical planes. Although it appears therefore that claim 26 lacks essential features, it appears that this claim could form a basis for an independent claim fulfilling the requirements of the PCT.

# INTERNATIONAL SEARCH REPORT

Inte Application No  
PCT/GB 99/03521

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E02B17/02 E02B17/06 E02B17/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 974 657 A (SUMNER MAURICE N) 17 August 1976 (1976-08-17) column 21, line 13 -column 23, line 26; figures 59-69	1, 17-19, 37, 38
X	US 3 385 069 A (ESTES JOHN C) 28 May 1968 (1968-05-28) column 2, line 7 - line 66; figures	1-4, 37
A	DE 29 30 203 A (THIELE HEINRICH) 19 February 1981 (1981-02-19) page 12, paragraph 3 -page 13, paragraph 2; figures 1-5	1, 17, 37, 38

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

19 January 2000

Date of mailing of the international search report

27/01/2000

Name and mailing address of the ISA

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Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

De Coene, P

# INTERNATIONAL SEARCH REPORT

Inte Application No

PCT/GB 99/03521

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 3 343 371 A (HELTkamp)</p> <p>26 September 1967 (1967-09-26)</p> <p>page 1, line 15 - line 50</p> <p>column 2, line 27 - line 48; figures</p> <p>-----</p>	<p>1, 2, 4, 5,</p> <p>17, 26,</p> <p>37, 38</p>

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/03521

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3974657 A	17-08-1976	US 3874180 A US 3948056 A	01-04-1975 06-04-1976
US 3385069 A	28-05-1968	DE 1558962 A FR 1540623 A GB 1197762 A NL 6713643 A SE 343354 B	23-04-1970 08-07-1970 08-04-1968 06-03-1972
DE 2930203 A	19-02-1981	NONE	
US 3343371 A	26-09-1967	NONE	

09/830388

-16-

JC03 Rec'd PCT/PTO 26 APR 2001

## Claims

1. An offshore structure comprising a base, a deck, and a plurality of lattice legs extending between the base and the deck, wherein the legs are arranged outboard of the deck and a connection is provided between an inwardly facing face of each said leg and the deck.
2. An offshore structure as claimed in claim 1, wherein each said lattice leg comprises a vertically extending chord at each corner thereof.
3. An offshore structure as claimed in claim 2, wherein each said leg chord is circular in cross section.
4. (Amended) An offshore structure as claimed in [any preceding] claim 1, wherein each said lattice leg is triangular.
5. (Amended) An offshore structure as claimed in [any of claims 2 to 4] claim 2, wherein the connection between each said leg and the deck comprises a shear plate attached substantially vertically between the deck and a said leg chord.
6. An offshore structure as claimed in claim 5, wherein the connection further comprises a stiffening plate extending through a diameter of the leg chord, wherein a first side edge of said shear plate is welded to said stiffening plate and said shear plate and said stiffening plate are substantially aligned.
7. An offshore structure as claimed in claim 6, wherein the stiffening plate extends over a greater length of the leg chord than the shear plate.

-17-

8. (Amended) An offshore structure as claimed in claim 6 [or 7], wherein the inboard end of said shear plate is welded between two plates extending outwardly from the deck edge.
9. (Amended) An offshore structure as claimed in [any of claims 5 to 8] claim 5, wherein the connection further comprises a further metal coupling plate attached horizontally between the deck and the leg chord.
10. An offshore structure as claimed in claim 9, wherein the coupling plate has a cut-out in an edge facing the leg chord, such that a part of the periphery of the leg chord is held within the cut-out.
11. An offshore structure as claimed in claim 10, wherein the cut-out is elliptical in shape.
12. (Amended) An offshore structure as claimed in [any of claims 9 to 11] claim 9, wherein a horizontal web is attached to the deck and the coupling plate is butt welded thereto.
13. (Amended) An offshore structure as claimed in [any of claims 9 to 12] claim 9, wherein plate stiffeners extending from the inboard end to the outboard end are provided in the coupling plate.
14. (Amended) An offshore structure as claimed in [any of claims 9 to 13] claim 9, wherein a coupling plate is provided at the top and the bottom of the shear plate.
15. An offshore structure as claimed in claim 14, wherein each coupling plate is welded to the shear plate at the join between the plates.
16. (Amended) An offshore structure as claimed in [any of claims 2 to 15] claim 2, wherein the connection is formed between the deck

-18-

and two said leg chords located at either end of the inwardly facing face of the lattice leg.

17. A method of installing an offshore structure comprising a base, a deck and a plurality of lattice legs located outboard of the deck, the method comprising the steps of: jacking the deck to the required height; forming a permanent connection between the deck and the legs; and removing the jacking system from the structure.

18. A method of installing an offshore structure as claimed in claim 17, wherein guides are provided on the deck so as to guide the deck as it is jacked up the legs.

19. A method of installing an offshore structure as claimed in claim 18, further comprising the steps of: attaching four legs to the base; attaching two guides to the deck; floating the deck over the base so that it passes between the legs until the guides abut against two said legs; and attaching another two guides to the deck.

20. (Amended) A method of installing an offshore structure as claimed in claim 18 [or 19], wherein the guides comprise beams attached to and projecting from the upper surface of the deck and being shaped for engaging a chord of a said leg.

21. (Amended) A method of installing an offshore structure as claimed in [any of claims 17 to 20] claim 17, wherein the deck is located relative to the legs prior to formation of the permanent connection.

22. A method of installing an offshore structure as claimed in claim 21, wherein the deck is located by

-19-

pulling the leg towards the deck so as to hold the leg chord against the guide.

23. A method of installing an offshore structure as claimed in claim 22, wherein a hydraulic tugger is provided between an outer edge of the leg and the deck so as to pull the leg towards the deck.

24. (Amended) A method of installing an offshore structure as claimed in [any of claims 21 to 23] claim 21, wherein hydraulic screw jacks are provided at the base of the deck so as to push the inboard leg chords away from the lower deck edge.

25. (Amended) A method of installing an offshore structure as claimed in [any of claims 22 to 24] claim 22, wherein the deck is pulled towards each of the legs.

26. A method of locating a deck of an offshore structure relative to a plurality of outboard lattice legs, said legs comprising a plurality of chords arranged at respective corners thereof, said method comprising the steps of pulling an outer leg chord towards said deck and pushing the leg chords located adjacent the deck away therefrom.

27. A method of locating a deck of an offshore structure relative to a plurality of outboard lattice legs as claimed in claim 26, wherein the outer leg chord is pulled towards the deck by means of a hydraulic tugger.

28. (Amended) A method of locating a deck of an offshore structure relative to a plurality of outboard lattice legs as claimed in claim 26 [or 27], wherein the leg chords located adjacent the deck are pushed away therefrom by means of hydraulic screw jacks extending



-20-

from the deck edge.

29. (Amended) A method of installing an offshore structure as claimed in [any of claims 17 to 25] claim 17, wherein the permanent connection is formed by welding a substantially vertically extending shear plate between a chord of the lattice leg and the deck edge.

30. A method of installing an offshore structure as claimed in claim 29, wherein a stiffening plate is provided through a diameter of the leg, and a first side edge of said shear plate is welded to said stiffening plate, and said shear plate and said stiffening plate are substantially aligned.

31. A method of installing an offshore structure as claimed in claim 30, wherein the stiffening plate extends over a greater length of the leg chord than the shear plate.

32. (Amended) A method of installing an offshore structure as claimed in claim 30 [or 31], wherein two plates are welded to the deck edge on respective sides of the shear plate and extending outwardly from the deck edge, and the inboard end of said shear plate is welded between the two plates.

33. (Amended) A method of installing an offshore structure as claimed in [any of claims 29 to 32] claim 29, wherein the connection further comprises a further metal coupling plate attached horizontally between the deck and the leg chord, the second metal plate having a cut-out in an edge facing the leg chord, such that a part of the periphery of the leg chord is held within the cut-out.

34. A method of installing an offshore structure as claimed in claim 33, wherein the cut-out is elliptical

-21-

in shape.

35. (Amended) A method of installing an offshore structure as claimed in claim 33 [or 34], wherein a coupling plate is provided at the top and the bottom of the shear plate.

36. (Amended) A method of installing an offshore structure as claimed in [any of claims 33 to 35] claim 33, wherein the shear plate and the coupling plate are welded together.

37. An offshore structure comprising a base, a deck, and a plurality of legs extending between the base and the deck, wherein the legs are arranged outboard of the deck and a connection is provided between an inwardly facing face of each said leg and the deck.

38. A method of installing an offshore structure comprising a base, a deck and a plurality of legs located outboard of the deck, the method comprising the steps of jacking the deck to the required height; forming a permanent connection between the deck and the legs; and removing the jacking system from the structure.

## ENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>24.67173/001</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 99/ 03521</b>	International filing date (day/month/year) <b>25/10/1999</b>	(Earliest) Priority Date (day/month/year) <b>26/10/1998</b>
Applicant <b>OVE ARUP PARTNERSHIP LIMITED et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

5

☐ None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No.

PC 99/03521

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E02B17/02 E02B17/06 E02B17/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 974 657 A (SUMNER MAURICE N) 17 August 1976 (1976-08-17) column 21, line 13 -column 23, line 26; figures 59-69 ---	1, 17-19, 37, 38
X	US 3 385 069 A (ESTES JOHN C) 28 May 1968 (1968-05-28) column 2, line 7 - line 66; figures ---	1-4, 37
A	DE 29 30 203 A (THIELE HEINRICH) 19 February 1981 (1981-02-19) page 12, paragraph 3 -page 13, paragraph 2; figures 1-5 --- -/--	1, 17, 37, 38

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

19 January 2000

Date of mailing of the international search report

27/01/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
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## INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 99/03521

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 343 371 A (HELTkamp) 26 September 1967 (1967-09-26)  page 1, line 15 - line 50 column 2, line 27 - line 48; figures -----	1, 2, 4, 5, 17, 26, 37, 38

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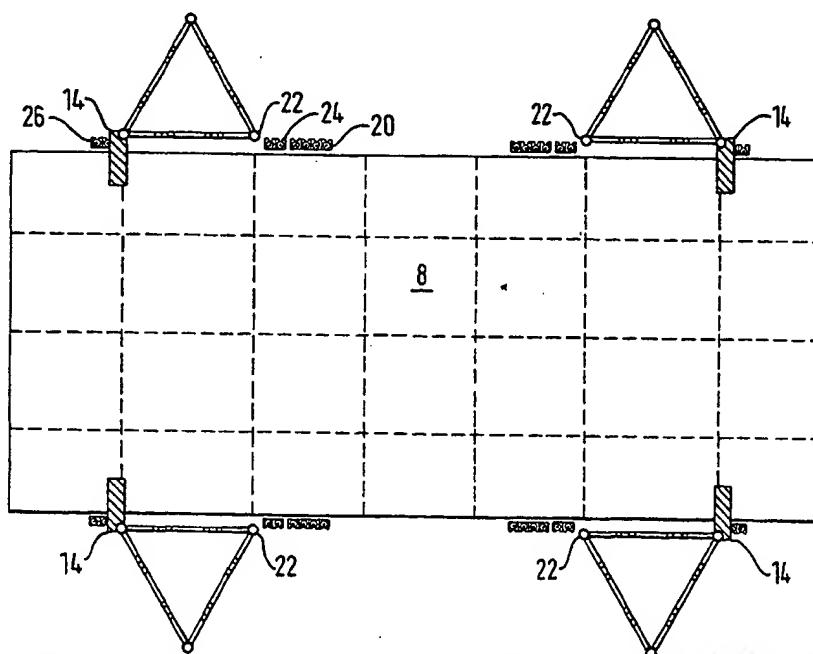
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(54) Title: OFFSHORE STRUCTURE



(57) Abstract

The present invention provides an offshore structure (2) comprising a base (4), a deck (8), and a plurality of lattice legs (6) extending between the base and the deck, wherein the legs are arranged outboard of the deck and a connection is provided between an inwardly facing face of each said leg and the deck.

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### Offshore Structure

5 The present invention relates to offshore structures such as for example, relocatable oil production platforms.

10 It is known in the art to provide offshore structures for use in oil production having a base, a number of legs and a platform which are pre-assembled before the entire structure is then transported to the production site. However, the transportation and installation of such structures is extremely costly and time consuming so that they are not easily relocatable.

15 Therefore it has been proposed in the art to provide offshore platforms in which a jacking system is used to lower the base to the seabed and to raise the platform to the required height above the base. Thus, ideally the deck or platform may be easily lowered and the base may be easily raised so that the entire structure can then be moved to a new site. Such platforms have a plurality of legs, a base and a platform and a rack and pinion type of jacking device has been used to raise and lower the base and platform as required. The rack and pinion provides a guide for the base and platform as they are being raised and lowered and also can be locked off so as to hold the platform at the required height while the rig is in use.

20 However, the jacking equipment required for such decks is expensive to produce and, in addition, as it remains permanently attached to the deck, it requires regular maintenance which is also extremely costly. Thus, if it were possible to remove the jacking system from the structure after installation, substantial savings could be made.

35 The present invention therefore seeks to provide an improved offshore structure in which a jacking system is not used to hold up the deck.

- 2 -

Therefore, from a first aspect, the present invention provides an offshore structure comprising a base, a deck and a plurality of legs extending between the base and the deck, wherein the legs are arranged outboard of deck and a connection is provided between an  
5 inwardly facing face of each said leg and the deck.

By providing legs located outboard of the platform, the deck may be raised to the required height relatively easily. Also, the formation of the connection between  
10 the legs and the deck allows the jacking system easily to be removed after installation. Thus, a standard jacking system can be hired for the duration of the installation of the structure, avoiding the manufacturing and maintenance costs involved with the  
15 permanent jacking systems of the prior art.

Preferably the deck is formed so that it does not include recesses for the legs. Preferably the deck is generally rectangular.

Most preferably the jacking system provided to  
20 raise the deck is also arranged entirely outside the line of the deck.

The legs could take any known form, for example tubular or, more preferably a lattice, for example a lattice made up of angle sections. Preferably each  
25 lattice leg comprises a vertically extending chord at each corner thereof. Still more preferably, each chord is circular in cross-section.

Further, the lattice leg may be of any shape which satisfies the design requirements for a particular  
30 structure. However, preferably the lattice leg is triangular.

The connection between each leg and the deck could be formed in any suitable manner. Preferably, the connection between each leg and the deck comprises a  
35 shear plate attached substantially vertically between the platform and a leg chord.

In certain design situations, the chord of the leg

- 3 -

could be of sufficient strength for the required loading. However, preferably the connection further comprises a stiffening plate extending through a diameter of the tubular member, wherein a first end of the shear plate is welded to the stiffening plate and the shear plate and the stiffening plate are substantially aligned.

This provides a relatively simple means of connecting the shear plate to the tubular member and also provides extra strength in the structure.

In the event that the base of the structure was lying level on the seabed, the deck could be raised to the same height on each of the legs of the structure. However, in order to provide tolerances in the level of the deck relative to the legs, thus allowing for different seabed conditions, the stiffening plate preferably extends over a greater length of the chord than the length of shear plate.

Thus, the shear plate need not be accurately aligned in the vertical direction before being welded to the stiffening plate.

Preferably, tolerance in the distance between the inboard end of the shear plate and the deck edge is also accommodated. Thus, preferably the inboard end of the shear plate is welded between two plates extending outwardly from the deck edge.

Preferably, the shear plate as described above carries only the shear forces between the platform and the legs. Therefore, the connection preferably further comprises at least one further coupling plate attached horizontally between the deck and the leg chords. This plate may carry tensile and compressive forces and bending moment loading applied between the deck and the legs.

The coupling plate could be attached to the tubular chord and the deck in any suitable manner. Preferably however, the coupling plate has a cut-out in its end

- 4 -

facing the leg chord, such that a part of the periphery of the leg chord is received within the cut-out. More preferably still, the cut-out is elliptical in shape. Therefore, a degree of tolerance in angular misalignment of the platform relative to the tubular leg is provided.

Although the coupling plate may be attached to the deck in any suitable manner, it is desirable that the plate be relatively simple to connect to the deck on-site. Preferably therefore, a horizontal web is attached to the deck and the coupling plate is butt welded thereto.

The coupling plate could be designed so as to be of sufficient strength itself to carry the necessary loading. However, preferably plate stiffeners extending from the inboard end to the outboard end and most preferably across the deck web are provided in the coupling plate. Still more preferably, a coupling plate is provided both at the top and the bottom of the shear plate.

Although it may be possible to attach the plates together in various ways, each coupling plate is preferably welded to the shear plate at the join between the plates.

Although a single connection could be provided between each of the legs and the deck, in a preferred embodiment of the invention, the connection is formed between the deck and two leg chords located at either end of the inwardly facing face of the lattice legs. Such an arrangement allows a stable connection to be formed between each leg and the deck.

In addition to the structure described above, a method of installing an offshore platform having some of the above described features is believed to be novel and inventive in its own right. Therefore, from a second aspect, the present invention provides a method of installing an offshore structure comprising a base, a deck and a plurality of legs located outboard of the

- 5 -

deck, the method comprising the steps of: jacking the deck to the required height; forming a permanent connection between the deck and the legs; and removing the jacking system from the structure.

5       As the legs of the structure are located entirely outboard of the deck, the deck may be jacked up the leg relatively easily without a high risk of it becoming obstructed. In addition, the removal of the jacking system allows the installation of the structure to be  
10       carried out at a significantly reduced cost.

      Also, the jacking mechanism is also preferably entirely located outside the line of the deck.

      Although as stated above, the deck would be unlikely to become obstructed when being jacked up the  
15       legs, guides are preferably provided on the deck so as to guide the deck as it is jacked up the leg. Thus, in severe wave and wind conditions as are often found on site, the deck is hindered from moving excessively relative to the legs. However, guides may not be  
20       necessary depending on the size of the platform, water depth and other factors.

      There will be many possible ways of assembling the base, deck, legs and guides relative to one another prior to installation of the platform. However,  
25       preferably, the method of installing the offshore structure further comprises the steps of: attaching four legs to the base; attaching two guides to the deck; floating the deck over the base so that it passes between the legs until the guides engage two of said  
30       legs; and attaching two guides to the deck.

      Thus two guides are installed after the deck has been floated into position so that they do not interfere with the positioning of the deck.

35       Preferably, the guides comprise beams attached to and projecting from the deck and being shaped for engaging a chord of a said leg.

      Preferably, the deck is located relative to the

- 6 -

legs prior to formation of the permanent connection. This allows some elements of the permanent connection to be prefabricated as their approximate dimensions will be known. In addition, as the deck cannot move relative to the legs once it has been located, the permanent connection is easier to make.

Preferably, the deck is located by pulling the leg towards the deck so as to hold a leg chord against the guide. Still more preferably, a hydraulic tugger is provided between an outer edge of the leg and the deck so as to pull the leg towards the deck.

In the method described above, the legs might skew slightly when the hydraulic tugger is tightened. This is because, the leg chord adjacent the guide would be held in position so that the other leg chord adjacent the deck would continue to be pulled towards the deck, effectively pivoting the leg about the guide.

Therefore, hydraulic screw jacks are preferably provided at the base of the platform so as to push the inboard leg chords away from the lower deck edge, thus locating the leg squarely adjacent the deck edge.

Each of the legs could be located relative to the deck one by one and the permanent connection formed after each leg was located. However, preferably, the deck is pulled towards each of the legs simultaneously. This allows the location of the deck relative to the legs to be adjusted so as to provide a relatively even gap between each of the legs and the deck.

The method of locating a deck of an offshore structure relative to a plurality of outboard lattice legs is further considered to be novel and inventive in its own right. Therefore, according to a third aspect, the present invention provides a method of locating a deck of an offshore structure relative to a plurality of outboard lattice legs, said legs comprising a plurality of chords arranged at respective corners thereof, said method comprising the steps of pulling an outer leg

- 7 -

chord towards said deck and pushing the leg chords located adjacent the deck away therefrom.

Preferably, the outer leg chord is pulled towards the deck by means of a hydraulic tugger.

5 Still more preferably, the leg chords located adjacent the deck are pushed away therefrom by means of hydraulic screw jacks extending from the deck edge.

When installing the offshore structure, the permanent connection could be made by any suitable  
10 means. However, preferably, the permanent connection is formed by welding a substantially vertically extending shear plate between a chord of the lattice leg and the deck edge. Still more preferably, a stiffening plate is provided through a diameter of the leg chord, and a  
15 first side edge of said shear plate is welded to said stiffening plate, and said shear plate and said stiffening plate are substantially aligned.

In order to allow for tolerance in the vertical level of the deck relative to the leg, the stiffening  
20 plate preferably extends over a greater length of the leg chord than the length of the shear plate.

In order to provide tolerance in the horizontal dimensions of the gap between the deck edge and the inboard edge of the stiffening plate, two plates are  
25 preferably welded to the deck edge on respective sides of the shear plate and extending outwardly from the deck edge, and the inboard end of the said shear plate is preferably welded between the two plates.

Preferably, the shear plate carries shear forces  
30 only such that the web plate does not have to line up precisely with the bulkhead of the deck. Therefore, the connection further preferably comprises a further coupling plate attached horizontally between the deck and the leg chord, the second plate having a cut-out in  
35 an edge facing the leg chord, such that a part of the periphery of the leg chord is received within the cut-out. Still more preferably, the cut-out is elliptical

in shape.

Although sufficient strength could be provided by a single coupling plate located either above or below the shear plate, preferably, a coupling plate is provided at the top and the bottom of the shear plate. Still more preferably, the shear plate and the coupling plate are welded together.

A preferred embodiment of the invention will now be described by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a side elevation of an offshore structure;

Figure 2 is a side elevation of the structure of Figure 1, showing the deck and the base in their final positions relative to the legs;

Figures 3.1 to 3.12 are a series of schematic drawings showing the construction and installation sequence of the offshore structure;

Figure 4 is a side elevation of a leg of the offshore structure, showing the arrangement of a jacking system relative to the leg;

Figure 5 is a top plan view of the offshore structure, showing the arrangement of installation guides relative to the legs of the structure;

Figure 6 is a detail as shown at A on Figure 5;

Figure 7 is a plan view of a leg of the structure showing how the leg is located relative to the deck;

Figure 8 is a section through AA of Figure 7;

Figure 9 is a perspective view showing the connection made between a chord of a leg of the structure and the platform;

Figure 10 is a top plan view of the connection between a leg of the structure and the platform;

Figure 11 is a section along line 1-1 as shown in Figure 10;

Figure 12 is a detail at point A as shown in Figure 11;



- 9 -

Figure 13 is a detail at point B as shown in Figure 10; and

Figure 14 is a section along line 2-2 of Figure 12.

As shown in Figures 1 and 2, an offshore production platform 2 is provided having a concrete gravity base 4 of conventional construction, four triangular section lattice legs 6, and a deck 8. When installed, the gravity base 4 lies on the seabed and a permanent connection is provided between the deck 8 and the legs 6 which are arranged outboard of the deck 8, which carries conventional topsides equipment.

As is further shown in Figure 2, lifting beams 10 are provided at the top of each of the lattice legs 6. During installation a jacking system, which will be discussed later will be attached between the lifting beams 10, the deck 8 and the base 4 so that the base and deck may be raised and lowered relative to one another.

The basic steps involved in the construction and installation of the various components of the offshore structure will now be described with reference to Figures 3.1 to 3.12.

As shown in Figure 3.1, the deck 8 of the structure is constructed at an onshore site. The deck 8 is of a generally standard rectangular construction and is designed to float, which avoids the need to use separate barges when transporting the structure to the installation site as will be shown below. In particular, the deck will provide buoyancy to transport the platform from its place of fabrication to the offshore site, will assist in installing the platform at that site, refloat the platform at the end of its useful life at that site, transport it to another site, and eventually remove the platform to shore to be scrapped.

The deck 8 is then launched onto a semi-submersible barge 12 which is submerged so that the deck 8 floats off onto the water (Figures 3.2 and 3.3). The deck 8 is then towed to a fitting out quay where the topsides are

- 10 -

installed on the deck (see Figure 3.4).

Figures 3.5 to 3.8 show the construction and installation of the gravity base 4 and legs 6 of the structure. As shown in Figure 3.5, the legs 6 and the base 4 are constructed on shore, one of the legs 6 then being attached to each of the four corners of the base 4 in a conventional manner. A jacking system (not shown) is then assembled between the base 4 and the legs 6. In particular a plurality of strand jacks are connected between the lifting beams 10 at the tops of the legs 4 and the gravity base. The jacking system is arranged outboard of the line of the deck 8.

Next, the base 4 is launched onto a semi-submersible barge 12, the barge is submerged and the base and legs are floated off the barge. The base 4 is then sunk in the shallow water close to the shore in preparation for mating with the deck 8.

As shown in Figure 3.9, to mate the base 4 and deck 8, the deck 8 is towed between the legs 6 so that it is positioned over the base 4. As shown in Figures 5 and 6, four guide members 14 are provided on the deck 8 so as to aid in installation of the structure. Each guide member 14 is made up of a steel beam having an L-shaped recess 16 in one end thereof. The recess 16 has a hardwood facing 17 to minimise contact damage. Two of the guide members 14 at one end of the deck 8 are attached to the upper surface of the deck 8, one on either side thereof, prior to engagement of the base 4 and deck 8, so that as the deck is towed between the legs 6, it will come to rest against two legs 6 of the structure when the respective guide members 14 abut these legs 6. Thus, the guide members are used loosely to locate the deck relative to the legs 6.

Once the deck 8 is in position over the base 4, the other two guide members 14 are fixed to the deck, with the other two legs received within the recesses 16 thereof. A clearance is left between them so as to

- 11 -

allow for tolerances later on in the installation process. The deck 8 and base 4 are then firmly secured together by jacking the base 4 up against the deck 8. The assembly is then towed offshore to the installation site as shown in Figure 3.10.

On arrival at the installation site, the base 4 is lowered to the seabed 18 as shown in Figure 3.11 and the platform is then jacked up to the required elevation as shown in Figure 3.12. Further details of those operations will now be discussed.

The arrangement of the jacking system 21 and the guide members 14 is shown in greater detail in Figures 4 to 6. As shown in Figures 4 and 5, the jacking system 21 includes eight jacks located adjacent each of the four legs 6 of the structure. A set of four jacks 20 for lowering the base 4 relative to the deck 8 on to the seabed is provided adjacent the inner inboard corner 22 of each of the triangular lattice legs 6. Two jacks 24 for raising the deck 8 are provided between each set of base lowering jacks 22 and each leg 6, and a further two deck raising jacks 26 are provided on the other side of each of the legs 6 adjacent the deck 8. Each guide member 14 extends from the deck 8 for location, to engage the outer inboard corner 28 of each leg 6, adjacent the two further deck raising jacks 26.

Figure 4 shows the eight jacks 20,24,26 adjacent one of the legs 6 in vertical perspective view. The jacks 20,24,26 are attached to the top of the legs 6 via the lifting beam 10. They extend parallel to the leg 6 to the base 4 where they are held in a jack anchorage 30. The deck 8 located between the lifting beam 10 and base 4 is attached to each of the jacks 20,24,26 via anchor plates 23 attached to the deck 8 after the deck has been floated into position on the base 4. The deck 8 and base 4 may be raised and lowered relative to one another and to the legs 6.

As can be seen from Figures 5 and 6, as the deck is

- 12 -

jacked up to the required height during installation, it will be located relative to the legs 6, but with some play, by the corner 28 of each leg abutting against the guide member 14. Typically a gap of approximately 1m is left between the deck edge 32 and each of the legs 6 and about 15 cm between the legs 6 and the guide end and the legs 6.

Once the deck has been raised to the required height by the jacking system, it is necessary to form a permanent connection between the deck 8 and the legs 6 so that the jacking system may be removed. In order to do this, the deck 8 is first more accurately located relative to the legs 6.

The means of locating the deck relative to the legs 6 are shown in Figures 7 and 8. As shown in Figure 7, each lattice leg 6 is triangular in shape and has a vertically extending chord 34 at each of its three corners. Two of the three corners of each triangular leg are arranged adjacent the deck edge 32. Thus, the third corner of the leg (referred to as the outboard chord) is positioned further outboard with respect to the deck 8.

To locate the deck, a strop 36 is attached around the outboard chord 34. A hydraulic tugger 38 is then attached between the strop and a padeye 40 provided at the bottom 42 of the deck edge 32. In addition, a pair of inwardly inclined hydraulic screw jacks 44 are positioned between fixed deck brackets 41 extending from the bottom 42 of the deck edge 32 and each of the inboard tubular members 34. The hydraulic tugger 38 is then tensioned so as to pull the respective leg 6 towards the deck 6 and, more specifically, the relevant chord 34 of the leg 6 against the guide member 14.

Next, the screw jacks 44 are activated to seat between the deck brackets 41 and the tubular members 34 and the hydraulic tugger 38 is tensioned further so as to hold the connection in position. As the guide

- 13 -

members 14 are positioned at the top surface of the deck 8 and the screw jacks at the bottom of the deck 8, the temporary connection formed to locate the deck relative to the legs 6, provides a relatively accurate means of location in both the horizontal and vertical planes.

After the deck has been located relative to the legs 6 as described above, a permanent connection is then formed between the deck and the legs 6. A schematic perspective view of the connection between an inboard chord 34 of a leg 6 and the deck edge 32 is shown in Figure 9. The connection is made up of a vertically extending steel shear plate 46 and upper 48 and lower 50 horizontally extending metal coupling plates. The connection is shown in greater detail in Figures 10 to 13. As shown in Figure 10, respective connections are made between each of the two inboard chords 34 of the leg and the deck edge 32.

One end of the shear plate 46 is butt welded to one end of a stiffening plate 52 which extends through the diameter of each of the inboard chords 34 to which a connection is to be made (see Figure 12). When making the connection, the shear plate 46 is firstly swung into position between a chord 34 and the deck edge 32. This plate 46 is then butt welded to the stiffening plate 52 along one of its outboard vertical edges. In order to allow for a degree of tolerance in vertical alignment between the legs and deck, the stiffening plate 52 extends over a greater length  $L_1$  of the chord 34 than the length  $L_2$  of the shear plate 46 to which it is welded. Indeed the stiffening plate extends upwardly as far as the lifting beam 10 in each leg 6.

The shear plate 46 is then attached to the platform edge as follows.

As shown in Figure 14, a first metal plate 54 is fillet welded to the deck edge 32 so that it extends out from the deck adjacent one side of the shear plate 46.

- 14 -

A second metal plate 56 is then fillet welded to the deck edge 32 so that it extends adjacent the other side of the shear plate 46. The shear plate 46 is then fillet welded to both of the metal plates 54 and 56.

5 This method of attachment means that the width of the shear plate 46 need not be exactly the same as the distance between the stiffening plate 52 and the deck edge, thereby providing a tolerance in the horizontal positioning of the deck 8 relative to the legs 6.

10 Once the shear plate 46 has been welded into position, the upper 48 and lower 50 coupling plates are then swung into position. The coupling plates 48,50 are formed with an elliptical cut-out 58 in their outboard edges, as shown in Figures 10 and 13, and each chord is  
15 received in a cut-out 58. As the cut-out 58 is elliptical rather than circular, in shape, some degree of angular tolerance is provided in the positioning of the coupling plate 48,50 relative to the chord 34. As can be seen from Figure 13, web 60 extends outwardly  
20 from the upper surface 62 of the deck edge 32. Location brackets 63 are pre-welded to the deck 8 and the web 60 so as to assist in alignment of the upper coupling plate 48,50 with the web 60. The coupling plate is then cut to size so as to fit between the web 60 and the chord.  
25 One end of the coupling plate 48,50 is positioned against the end of the web 60 and butt welded to the web, while the other end of the coupling 48,50 is butt welded to the chord 34 around the circumference of the cut-out 58. The coupling plates 48,50 are also fillet  
30 welded to the shear plate 46. Thus, again, tolerance is allowed in the horizontal distance between the leg and platform. Plate stiffeners 64 are also welded across the coupling plates 48 and 50 and their respective webs 60.

35 The connection between the deck 8 and each leg chord 34 thus comprises a shear plate 46, and two coupling plates 48,50, and this provides a strong

- 15 -

connection capable of withstanding both shear and bending loads.

5       Once a connection as described above has been made between the two chords 34 of each leg 6 and the deck 8, the jacking system may then be removed.

10       It will be appreciated by those skilled in the art that many modifications could be made to the embodiment of the invention described above without departing from the scope of the invention as claimed. Thus, the platform may have any number of legs and those legs could be of any shape, for example, they could be square. Furthermore, the invention may also be applicable to structures having legs which do not have a lattice structure.

15

## Claims

1. An offshore structure comprising a base, a deck,  
and a plurality of lattice legs extending between the  
5 base and the deck, wherein the legs are arranged  
outboard of the deck and a connection is provided  
between an inwardly facing face of each said leg and the  
deck.
- 10 2. An offshore structure as claimed in claim 1,  
wherein each said lattice leg comprises a vertically  
extending chord at each corner thereof.
3. An offshore structure as claimed in claim 2,  
15 wherein each said leg chord is circular in cross  
section.
4. An offshore structure as claimed in any preceding  
claim, wherein each said lattice leg is triangular.
- 20 5. An offshore structure as claimed in any of claims 2  
to 4, wherein the connection between each said leg and  
the deck comprises a shear plate attached substantially  
vertically between the deck and a said leg chord.
- 25 6. An offshore structure as claimed in claim 5,  
wherein the connection further comprises a stiffening  
plate extending through a diameter of the leg chord,  
wherein a first side edge of said shear plate is welded  
30 to said stiffening plate and said shear plate and said  
stiffening plate are substantially aligned.
7. An offshore structure as claimed in claim 6,  
wherein the stiffening plate extends over a greater  
35 length of the leg chord than the shear plate.



- 17 -

8. An offshore structure as claimed in claim 6 or 7, wherein the inboard end of said shear plate is welded between two plates extending outwardly from the deck edge.

5

9. An offshore structure as claimed in any of claims 5 to 8, wherein the connection further comprises a further metal coupling plate attached horizontally between the deck and the leg chord.

10

10. An offshore structure as claimed in claim 9, wherein the coupling plate has a cut-out in an edge facing the leg chord, such that a part of the periphery of the leg chord is held within the cut-out.

15

11. An offshore structure as claimed in claim 10, wherein the cut-out is elliptical in shape.

20

12. An offshore structure as claimed in any of claims 9 to 11, wherein a horizontal web is attached to the deck and the coupling plate is butt welded thereto.

25

13. An offshore structure as claimed in any of claims 9 to 12, wherein plate stiffeners extending from the inboard end to the outboard end are provided in the coupling plate.

30

14. An offshore structure as claimed in any of claims 9 to 13, wherein a coupling plate is provided at the top and the bottom of the shear plate.

35

15. An offshore structure as claimed in claim 14, wherein each coupling plate is welded to the shear plate at the join between the plates.

16. An offshore structure as claimed in any of claims 2 to 15, wherein the connection is formed between the deck

- 18 -

and two said leg chords located at either end of the inwardly facing face of the lattice leg.

17. A method of installing an offshore structure  
5 comprising a base, a deck and a plurality of lattice  
legs located outboard of the deck, the method  
comprising the steps of: jacking the deck to the  
required height; forming a permanent connection between  
the deck and the legs; and removing the jacking system  
10 from the structure.

18. A method of installing an offshore structure as  
claimed in claim 17, wherein guides are provided on the  
deck so as to guide the deck as it is jacked up the  
15 legs.

19. A method of installing an offshore structure as  
claimed in claim 18, further comprising the steps of:  
attaching four legs to the base; attaching two guides to  
20 the deck; floating the deck over the base so that it  
passes between the legs until the guides abut against  
two said legs; and attaching another two guides to the  
deck.

20. A method of installing an offshore structure as  
25 claimed in claim 18 or 19, wherein the guides comprise  
beams attached to and projecting from the upper surface  
of the deck and being shaped for engaging a chord of a  
said leg.

30 21. A method of installing an offshore structure as  
claimed in any of claims 17 to 20, wherein the deck is  
located relative to the legs prior to formation of the  
permanent connection.

35 22. A method of installing an offshore structure as  
claimed in claim 21, wherein the deck is located by

- 19 -

pulling the leg towards the deck so as to hold the leg chord against the guide.

23. A method of installing an offshore structure as  
5 claimed in claim 22, wherein a hydraulic tugger is provided between an outer edge of the leg and the deck so as to pull the leg towards the deck.

24. A method of installing an offshore structure as  
10 claimed in any of claims 21 to 23, wherein hydraulic screw jacks are provided at the base of the deck so as to push the inboard leg chords away from the lower deck edge.

25. A method of installing an offshore structure as  
15 claimed in any of claims 22 to 24, wherein the deck is pulled towards each of the legs.

26. A method of locating a deck of an offshore  
20 structure relative to a plurality of outboard lattice legs, said legs comprising a plurality of chords arranged at respective corners thereof, said method comprising the steps of pulling an outer leg chord towards said deck and pushing the leg chords located  
25 adjacent the deck away therefrom.

27. A method of locating a deck of an offshore  
structure relative to a plurality of outboard lattice legs as claimed in claim 26, wherein the outer leg chord  
30 is pulled towards the deck by means of a hydraulic tugger.

28. A method of locating a deck of an offshore  
structure relative to a plurality of outboard lattice  
35 legs as claimed in claim 26 or 27, wherein the leg chords located adjacent the deck are pushed away therefrom by means of hydraulic screw jacks extending

- 20 -

from the deck edge.

29. A method of installing an offshore structure as claimed in any of claims 17 to 25, wherein the permanent  
5 connection is formed by welding a substantially vertically extending shear plate between a chord of the lattice leg and the deck edge.

30. A method of installing an offshore structure as  
10 claimed in claim 29, wherein a stiffening plate is provided through a diameter of the leg, and a first side edge of said shear plate is welded to said stiffening plate, and said shear plate and said stiffening plate are substantially aligned.

15 31. A method of installing an offshore structure as claimed in claim 30, wherein the stiffening plate extends over a greater length of the leg chord than the shear plate.

20 32. A method of installing an offshore structure as claimed in claim 30 or 31, wherein two plates are welded to the deck edge on respective sides of the shear plate and extending outwardly from the deck edge, and the  
25 inboard end of said shear plate is welded between the two plates.

33. A method of installing an offshore structure as  
30 claimed in any of claims 29 to 32, wherein the connection further comprises a further metal coupling plate attached horizontally between the deck and the leg chord, the second metal plate having a cut-out in an edge facing the leg chord, such that a part of the periphery of the leg chord is held within the cut-out.

35 34. A method of installing an offshore structure as claimed in claim 33, wherein the cut-out is elliptical

- 21 -

in shape.

35. A method of installing an offshore structure as claimed in claim 33 or 34, wherein a coupling plate is  
5 provided at the top and the bottom of the shear plate.

36. A method of installing an offshore structure as claimed in any of claims 33 to 35, wherein the shear  
10 plate and the coupling plate are welded together.

37. An offshore structure comprising a base, a deck,  
and a plurality of legs extending between the base and  
the deck, wherein the legs are arranged outboard of the  
deck and a connection is provided between an inwardly  
15 facing face of each said leg and the deck.

38. A method of installing an offshore structure comprising a base, a deck and a plurality of legs located outboard of the deck, the method comprising the  
20 steps of jacking the deck to the required height;  
forming a permanent connection between the deck and the legs; and removing the jacking system from the structure.

1/13

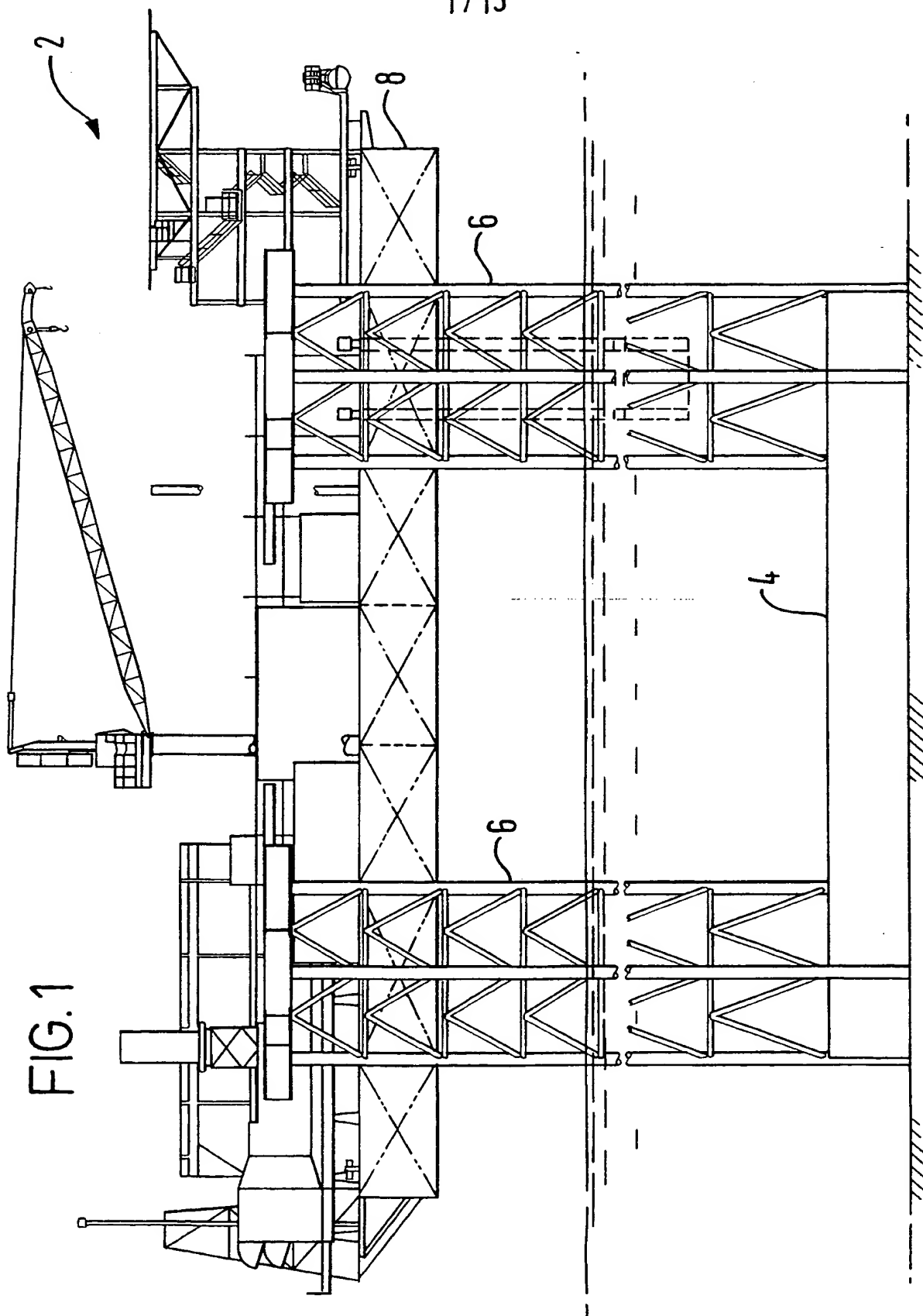


FIG. 1

2/13

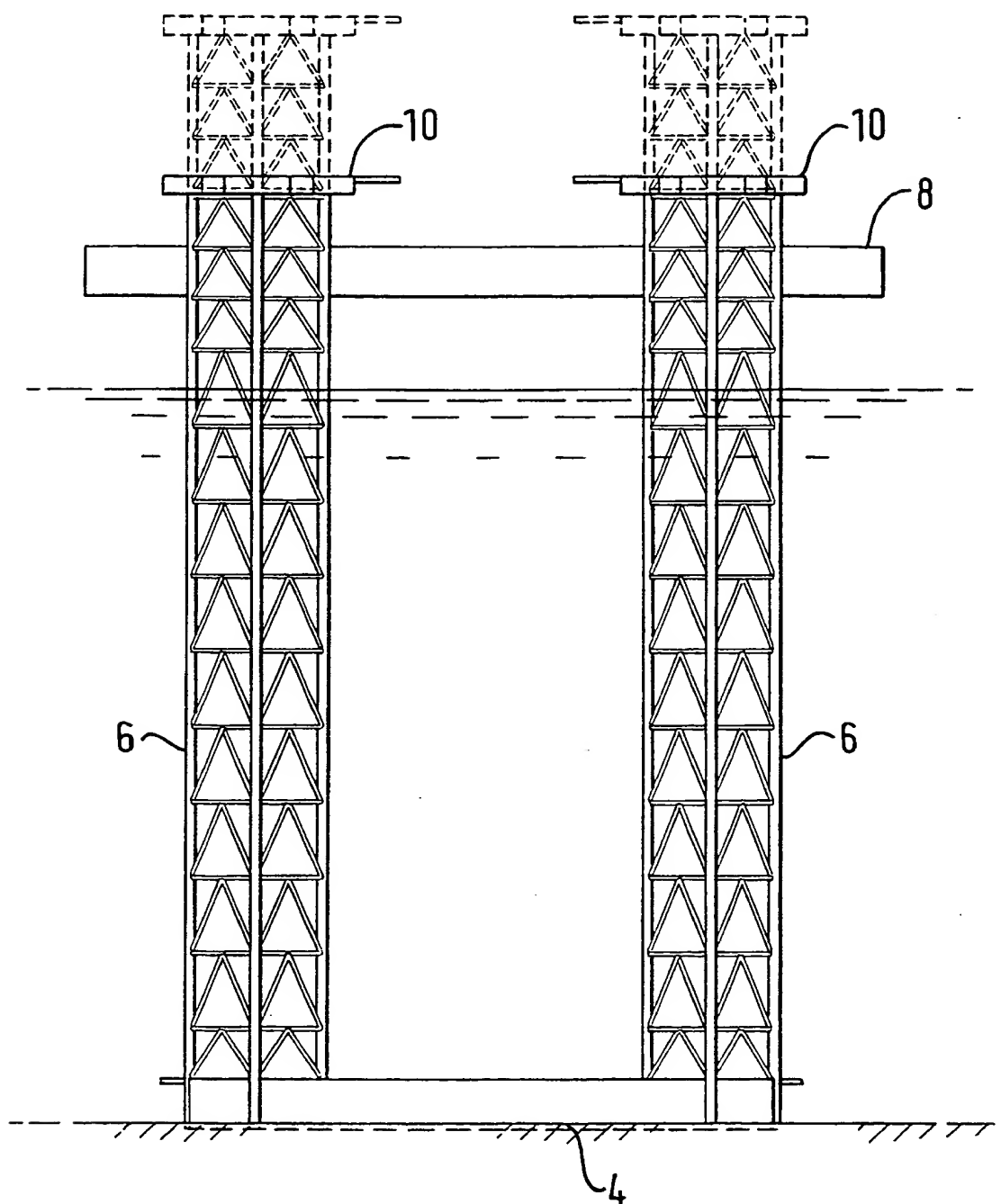
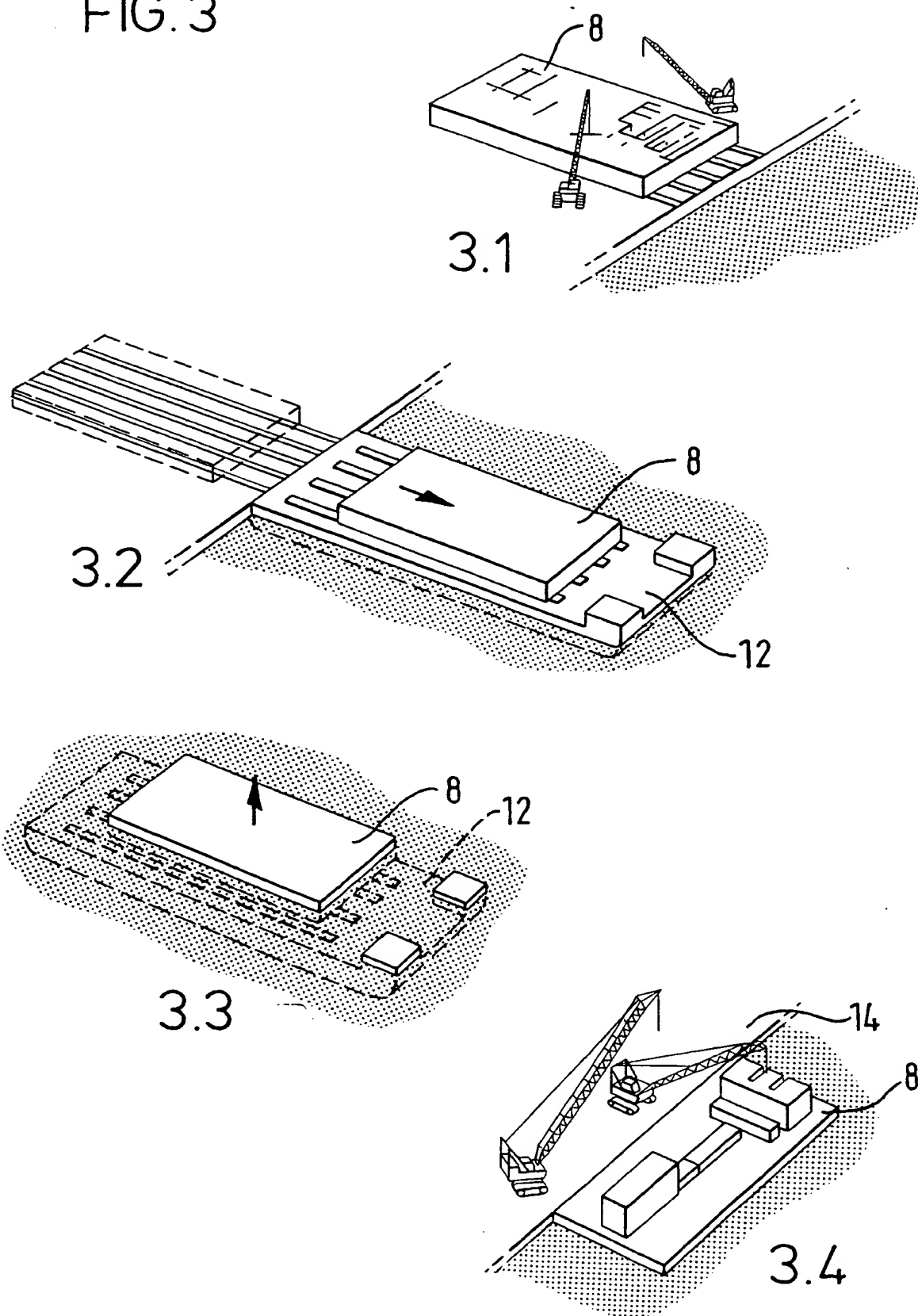


FIG. 2

3 / 13

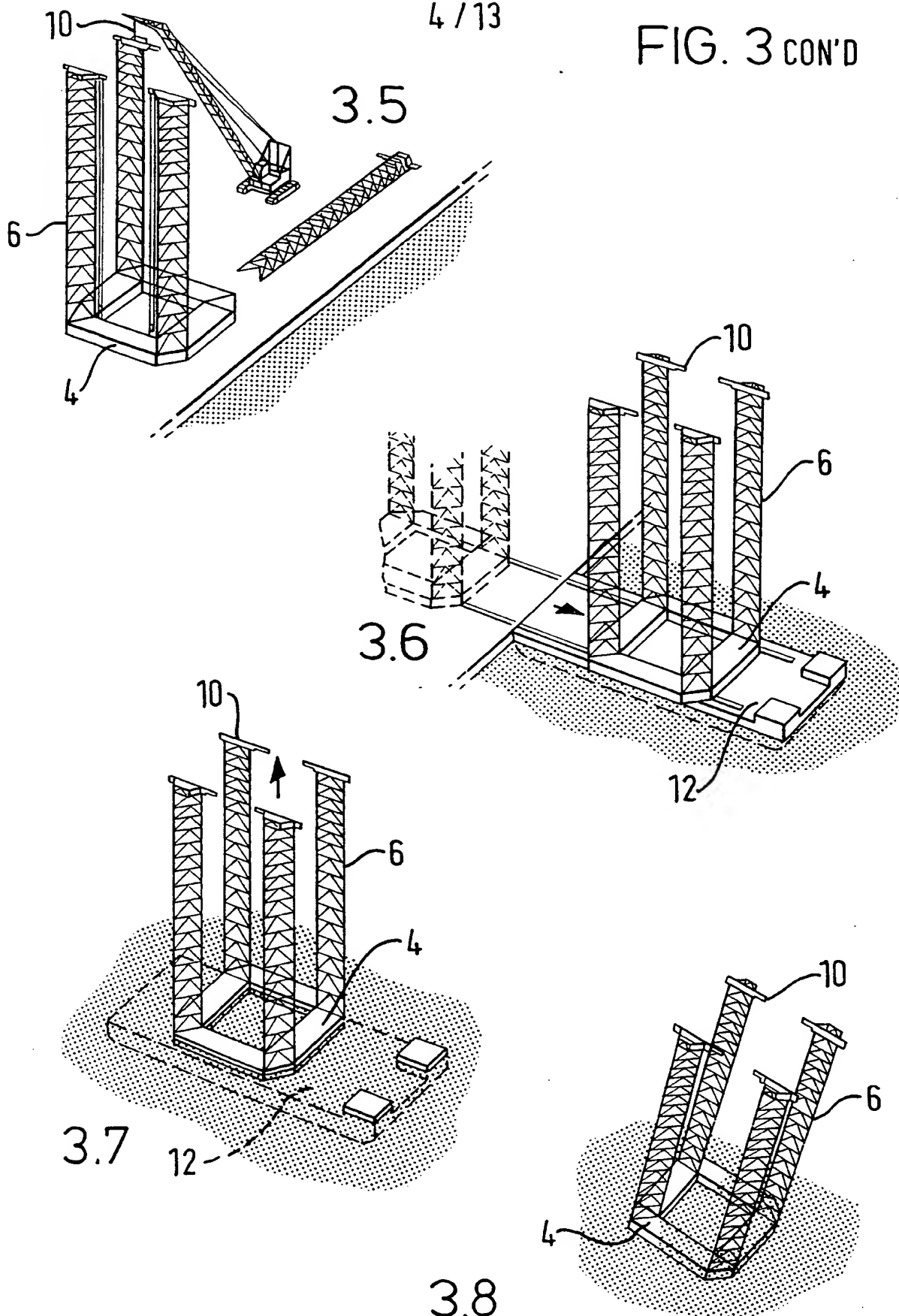
FIG. 3





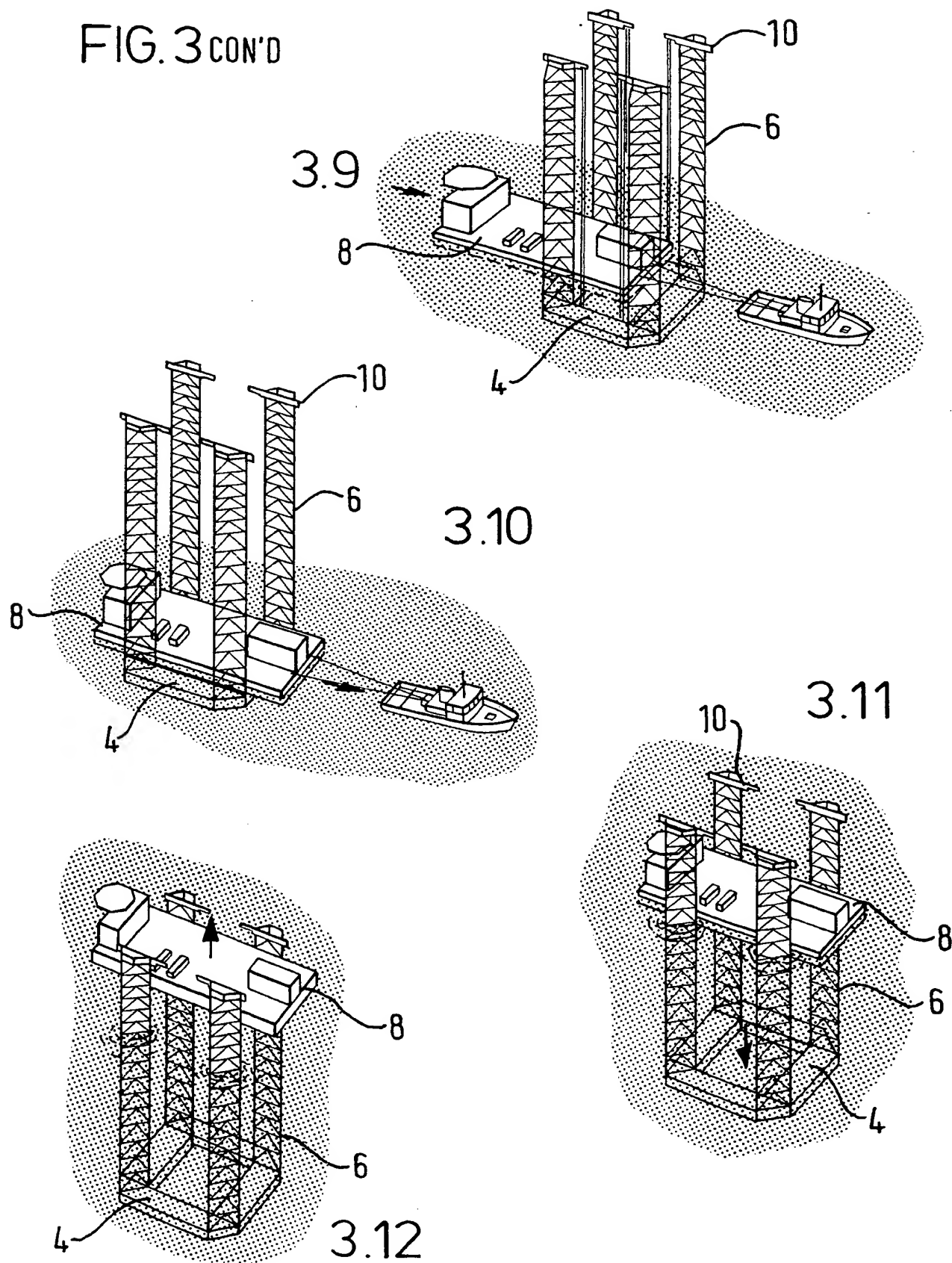
4 / 13

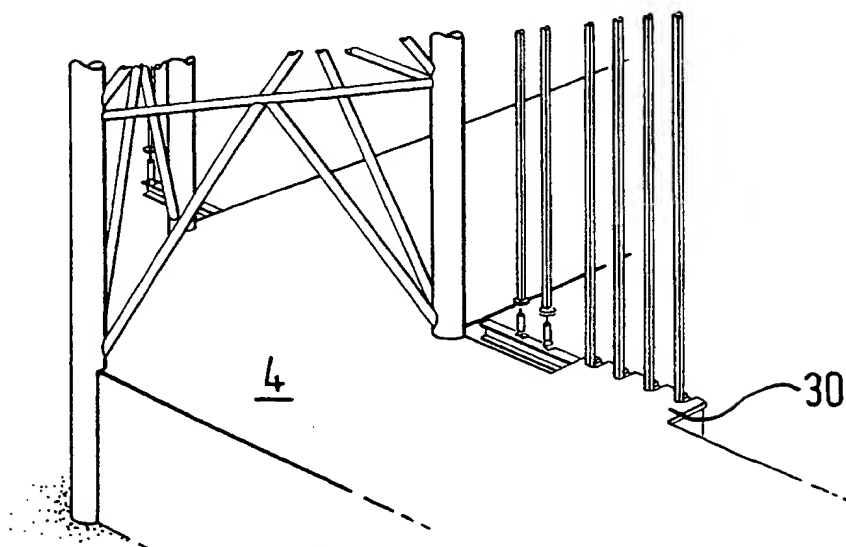
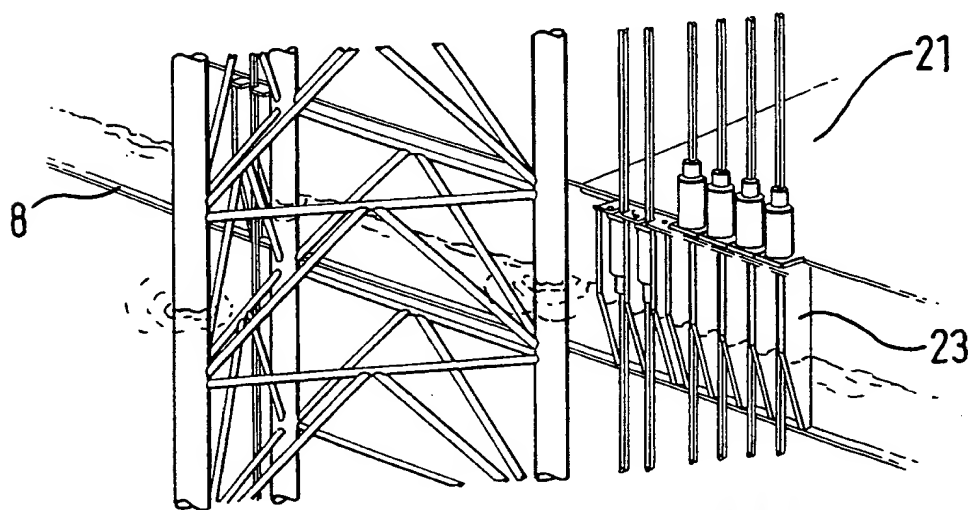
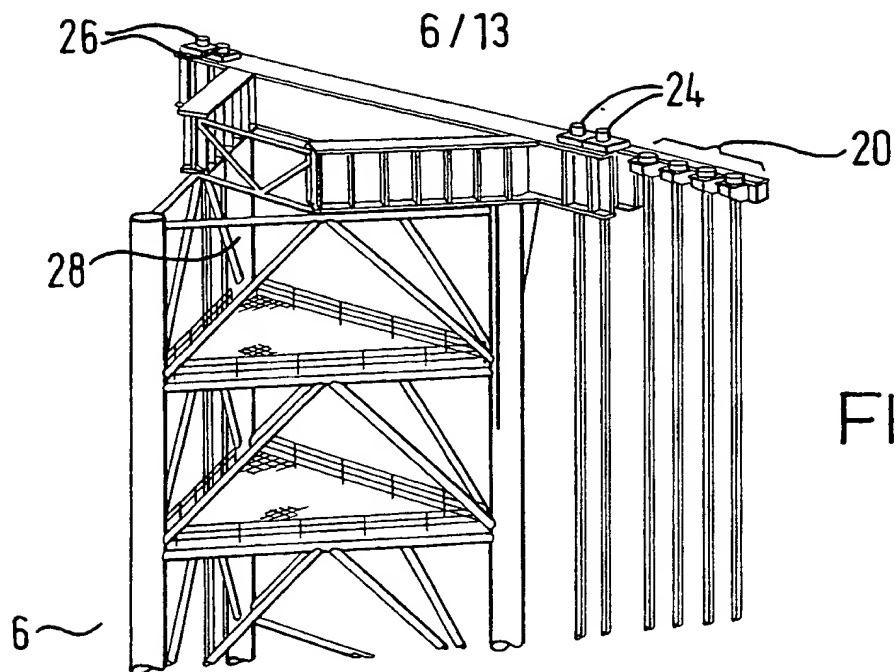
FIG. 3 CON'D



5/13

FIG. 3 CON'D





7/13

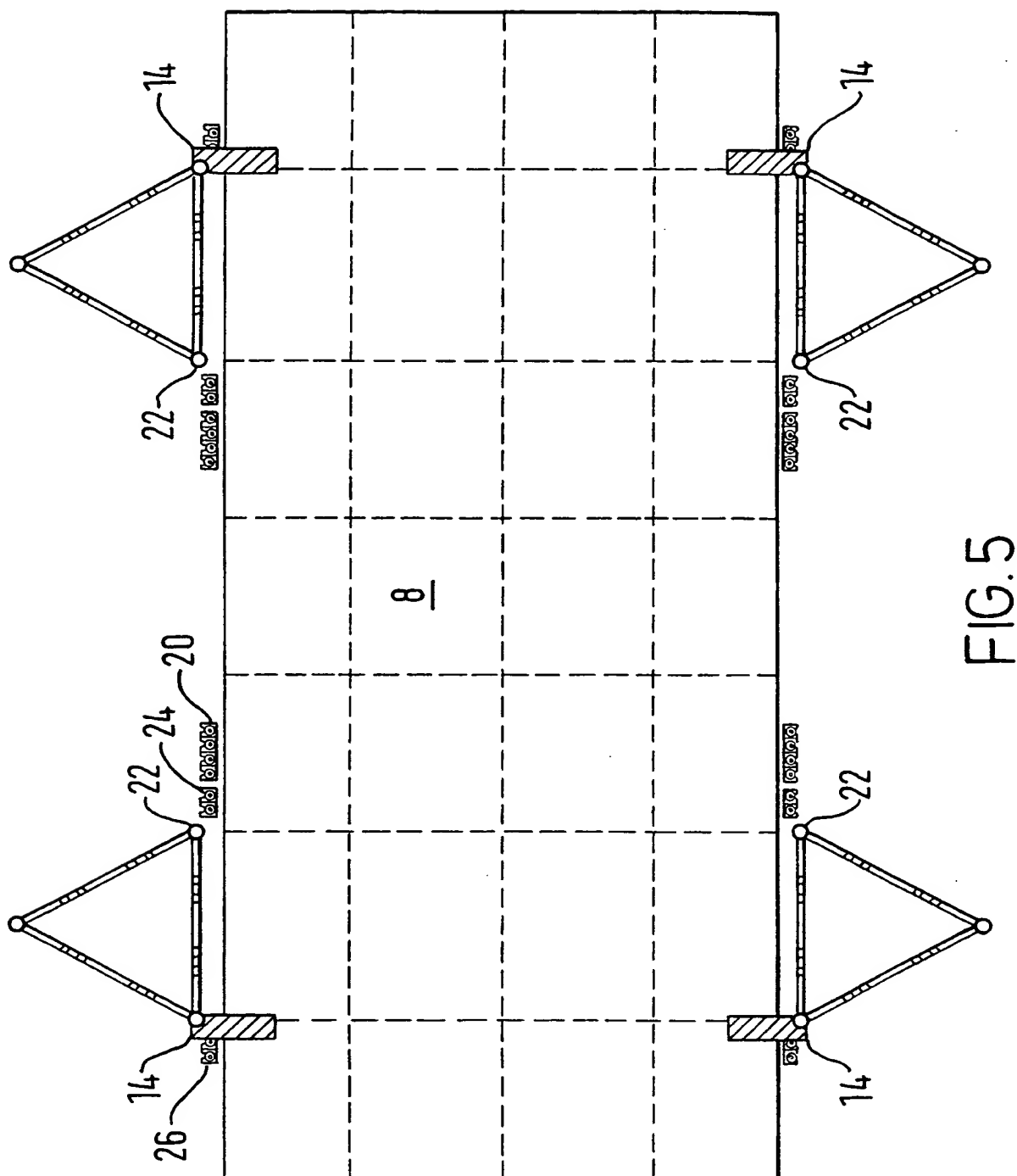
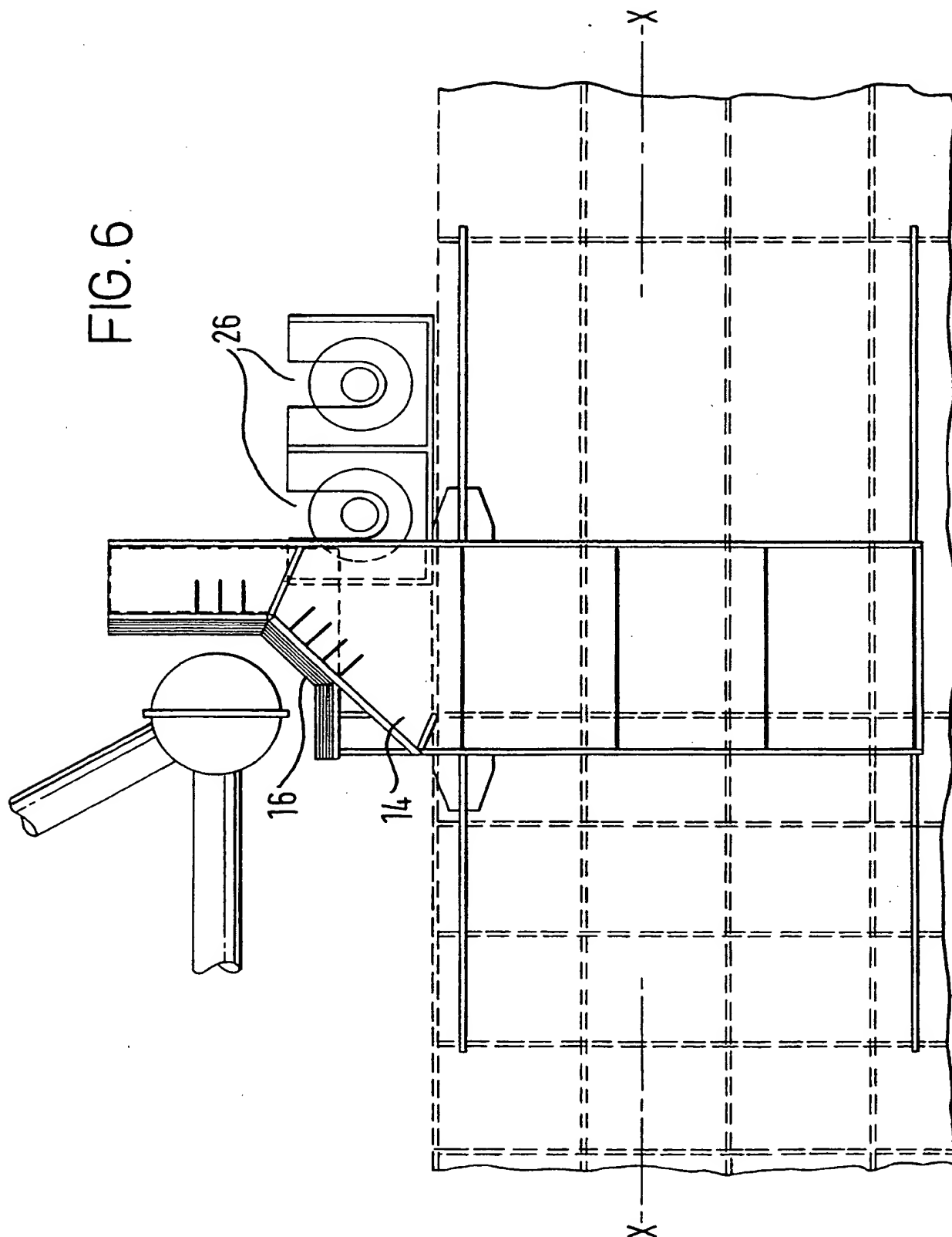


FIG. 5

8/13

FIG. 6



9/13

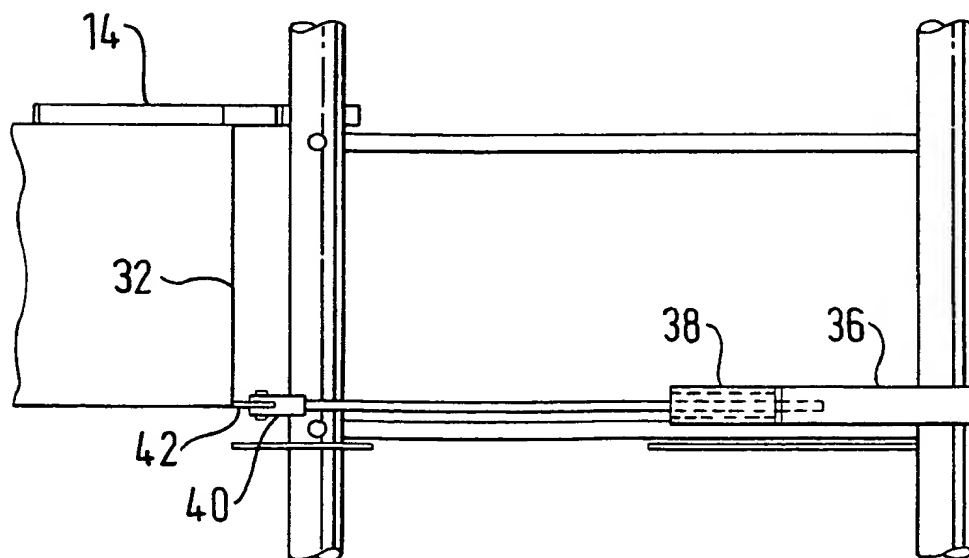
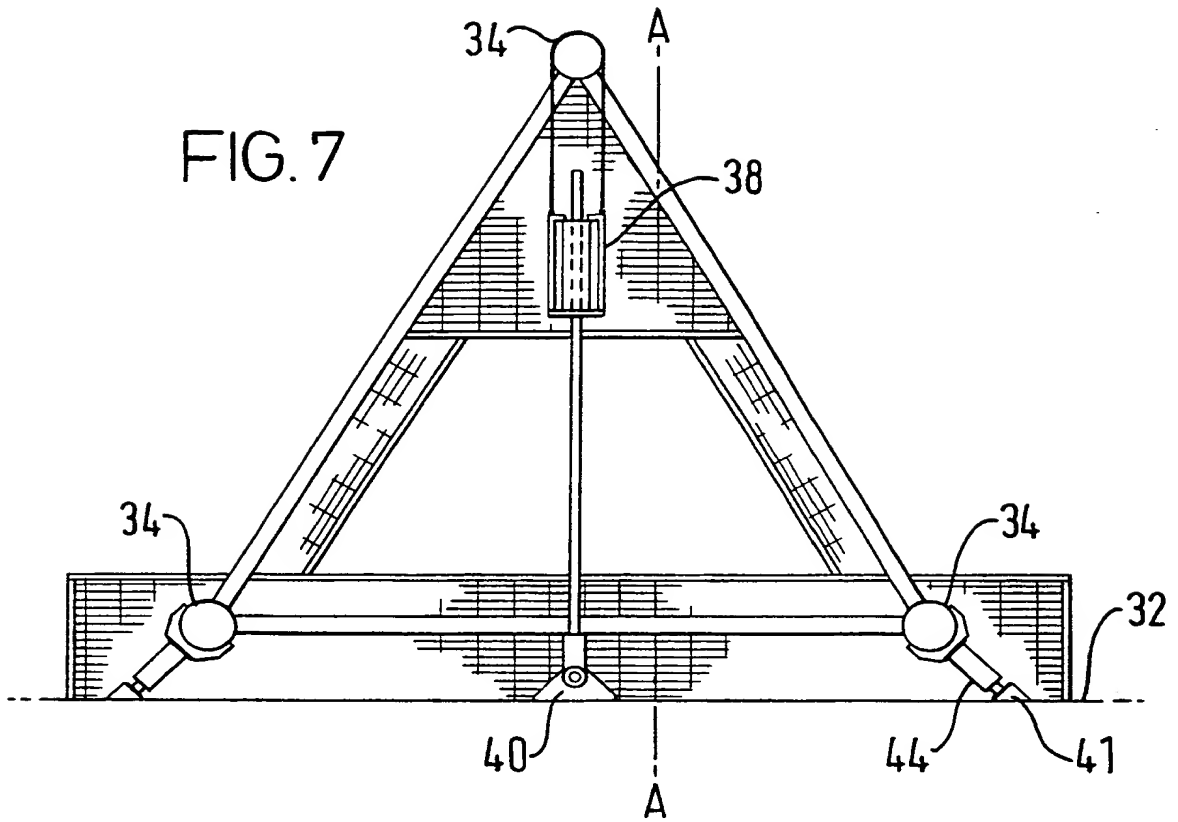


FIG. 8

10/13

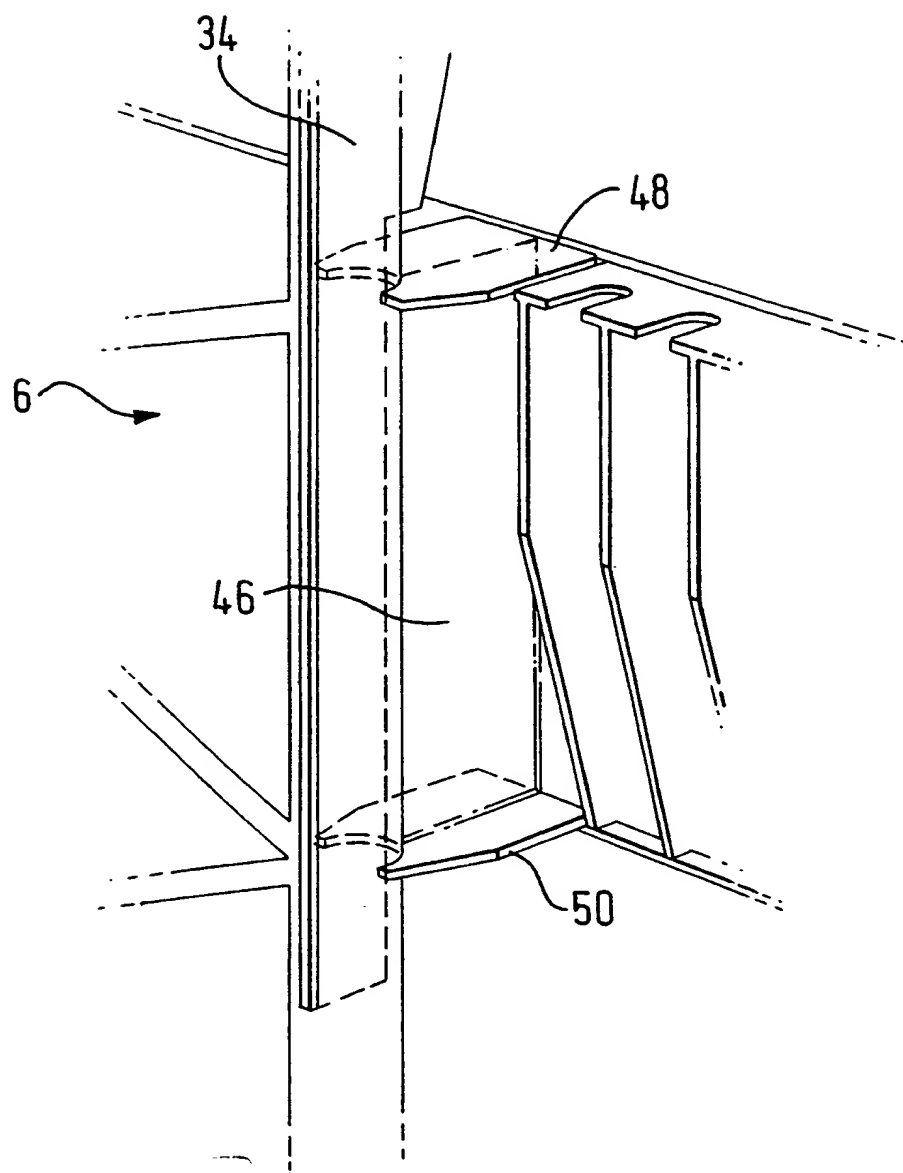


FIG. 9

11/13

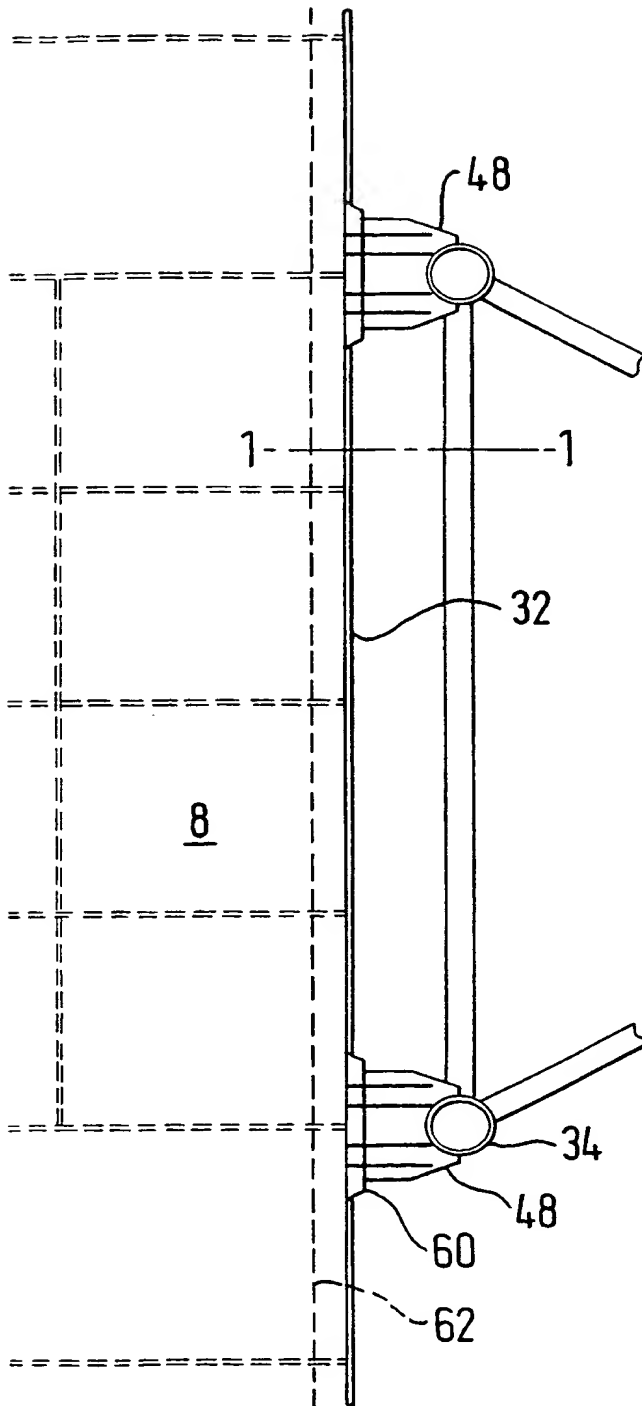


FIG. 10

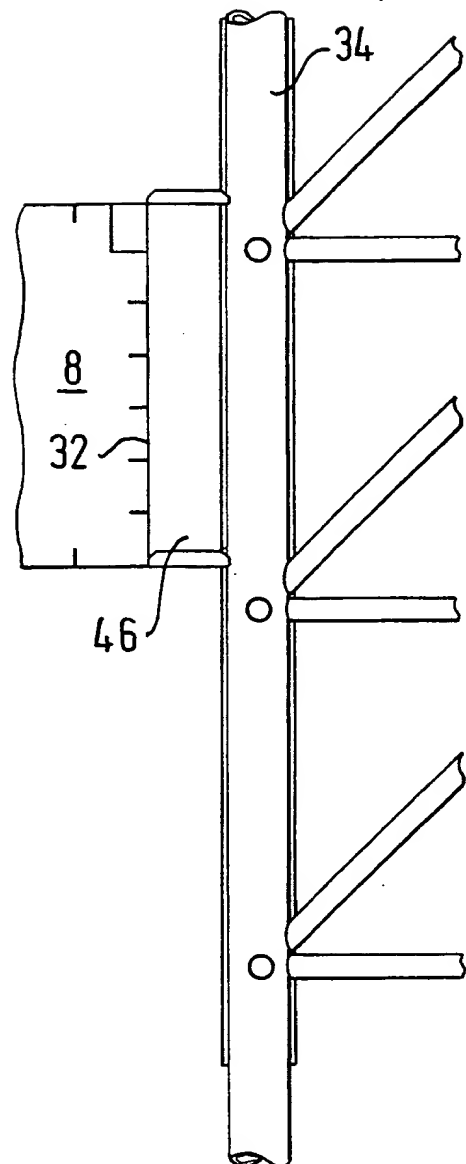


FIG. 11



12 / 13

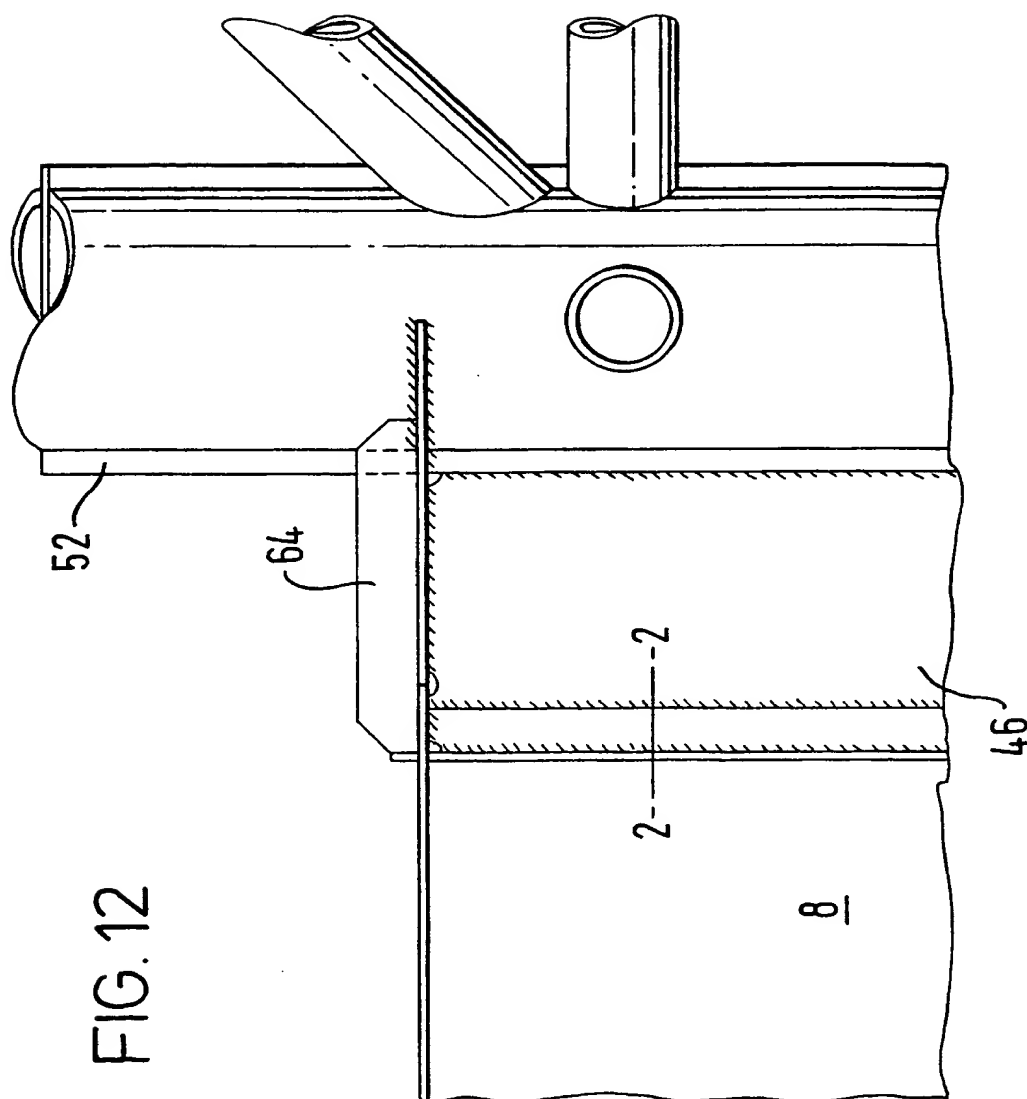


FIG. 12

13/13

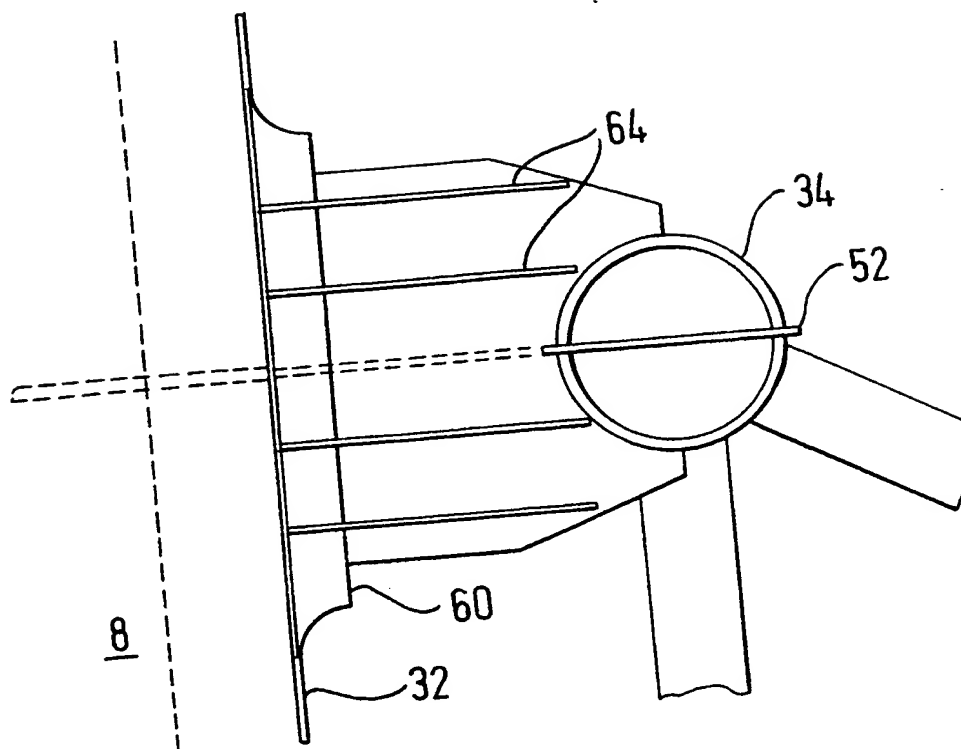


FIG. 13

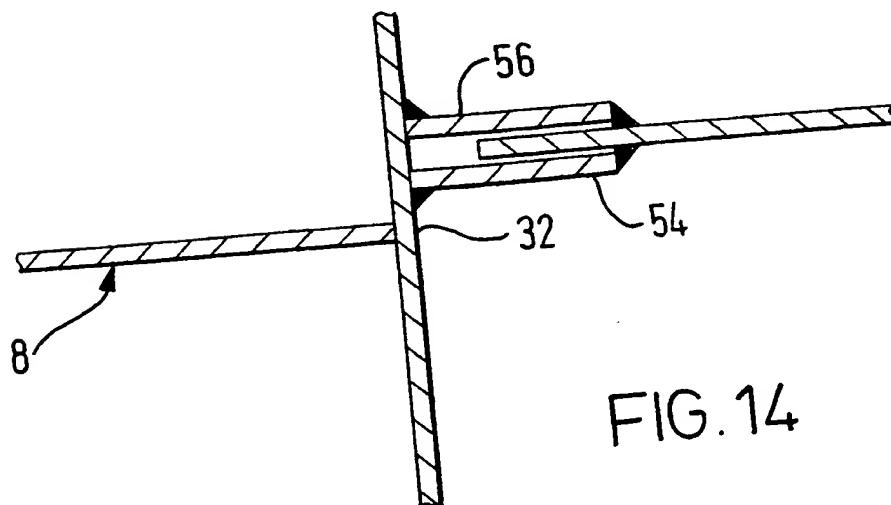


FIG. 14